Synchro Studio Training Course

Location

Date

Trafficware

Calculations

- Delay Calculations
  - Synchro Control Delay
    - Based on the Synchro Percentile Delay Method
    - Reported in the INT: reports and the Timing Window
  - HCM Signals Delay
    - Based on the 2000 HCM Methods
    - Create a HCM Signal Report (Reports Window)

Trafficware

Percentile Delay

- Percentile Scenarios

$$\lambda = v * \frac{C}{3600}$$

$$vP = (\lambda + z\rho) * \frac{3600}{C}$$

Percentile	Z
10	-1.28
30	-0.52
50	0
70	0.52
90	1.28

Trafficware

Percentile Delay

- Actuated Signal Considerations
  - Determine Skip Probability

Handout

Refer to the Calculations Handout 'Skipping'. Also, refer to the sample file 'C:/Class Files/D. Advanced/01 Calculations.xls' and the Synchro file 'C:/Class Files/D. Advanced/01 Calc Examples.sy6'.

  - Determine Queue Clear Time
    - This is the startup lost time plus the

Handout

Refer to the Calculations Handout 'Queue Clear'. Also, refer to the sample file 'C:/Class Files/D. Advanced/01 Calculations.xls' and the Synchro file 'C:/Class Files/D. Advanced/01 Calc Examples.sy6'.

Trafficware

Percentile Delay

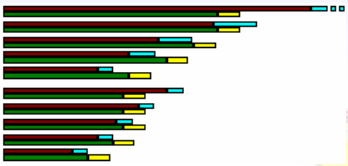
- Actuated Signal Considerations
  - Determine Time to Gap-Out

Handout

Refer to the Calculations Handout 'Gap Time'. Also, refer to the sample file 'C:/Class Files/D. Advanced/01 Calculations.xls' and the Synchro file 'C:/Class Files/D. Advanced/01 Calc Examples.sy6'.

  - Dependent on the detector placement and vehicle extension time

4 SBTL	90th	56.0	11.0	39.0	Max Out
	70th	38.2	8.0	39.0	Max Out
	50th	28.3	6.0	34.7	Hold
	30th	22.9	5.0	29.7	Hold
	10th	17.2	3.0	22.9	Hold
5 EBL	90th	29.9	3.0	22.0	Max Out
	70th	24.5	3.0	22.0	Max Out
	50th	20.7	3.0	22.0	Max Out
	30th	17.1	3.0	20.1	Gap Out
	10th	12.6	3.0	15.6	Gap Out



Trafficware

Percentile Delay

- Percentile Delay Summary
  - Arrivals will vary according to a Poisson distribution
  - Skipping and gap-out modeled
  - Arrivals flow pattern is calculated
  - Delays based on calculated volumes & greens
  - Calculations are performed iteratively
  - Additional time added for saturated conditions

Trafficware

Calculations

- Discussion
  - How do Synchro Delays compare to the HCM Signal Report and to the HCS?

Movement	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Total	LOS
Synchro Delay	6.1	6.9	34.1	7.6	25.4	35.7	64.2	31.7	15.7	B
HCM Signal Delay	5.8	6.4	26.8	7.0	24.5	33.4	51.8	30.7	14.2	B
HCS Delay	2.6	7.0	19.8	5.0	24.3	33.3	43.0	30.4	12.8	B

Trafficware

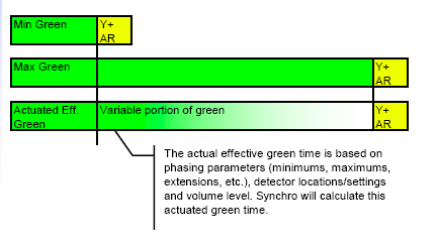
Ca

Item	Synchro	Synchro HCM Report	Highway Capacity Software (HCS)
Percentile Method (see note 1)	Synchro uses a Poisson distribution to determine five representative volume levels (10th, 30th, 50th, 70th and 90th Percentiles)	Uses a single volume analysis. This single volume would be the same as Synchro's 50th Percentile Volume.	Uses a single volume analysis. This single volume would be the same as Synchro's 50th Percentile Volume.
Actuated Green Inputs (See note 2)	In Synchro, the user inputs the actuated parameters such as minimums and maximums. The Actuated Green time is calculated for five percentile scenarios.	This will use the average of Synchro's five Percentile green times.	In traditional HCM software, the user must determine and enter the actuated green times.
Dual Ring Control (see note 3)	Uses Dual Ring	Uses Dual Ring	Uses Single Ring
Progression Factor (PF) (see note 4)	Synchro explicitly calculates the PF based on upstream arrivals (via integration, see note 4)	The HCM Report will calculate the PF from Synchro Percentile integration. This is the Percentile Delay Coordinated divided by the Percentile Delay Uncoordinated.	The HCS asks the user to enter an Arrival Type from 1 to 6.
Right Turn on Red (RTOR) (see note 5)	Synchro calculates the RTOR and makes a saturation flow adjustment. This will increase the capacity for the movement.	The HCM methods subtract the RTOR volume from the analysis. (see note 5)	
Miscellaneous	The RTOR adjustment can impact the permitted left turn calculation.		

Trafficware

Calculations

2 **Actuated Green Inputs**. For the case study, the signal timings were transferred from Synchro to the HCS. Synchro will transfer actuated green times, not maximum or minimums. However, if the data is hand entered in the HCS, this can be a large cause for differences in results.

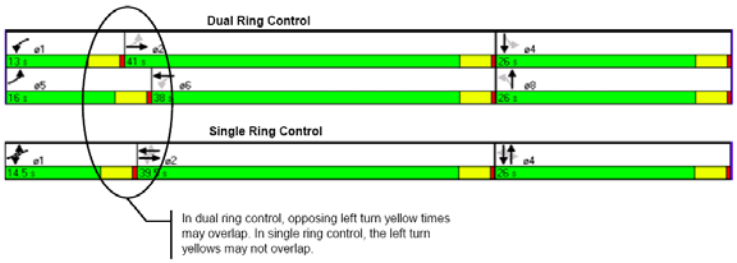


Trafficware

Calculations

3 **Single Ring vs. Dual Ring.** The HCS requires the timing to be in single ring format, Synchro (both methods) calculate delay with dual rings. In practical terms, if yellows overlap for opposing lefts, the HCS requires you to use the same time for the lefts and throughs (see the image below).

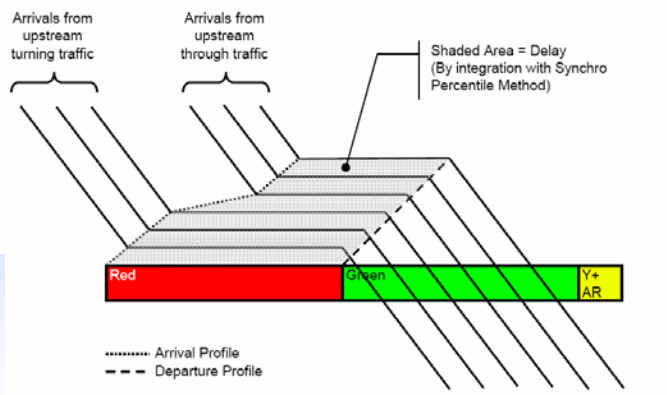
In the case study, notice that the EBL and WBL values differ greatly between the Synchro methods (Percentile and HCM Signal Report) when compared with the HCS. This has to do with Synchro using dual ring control (even for the HCM Signal Report).



Trafficware

Calculations

4



Trafficware

Calculations

5 **RTOR**. In Synchro, the RTOR is a saturation flow increase. For the HCM methods, the RTOR is a volume reduction. These RTOR vehicles that are excluded are often low delayed vehicles so the only ones left are those that are getting delayed. Also, the result shown is the Delay per Vehicle. Since the HCM method has a higher aggregate delay, and a lower number of vehicles in the denominator, the delay per vehicle will be higher.

Trafficware

Calculations

- Queue Length
  - 50th percentile and 95th percentile queue
  - maximum distance where vehicles stop/cycle

Trafficware

Calculations

- Discussion
  - How does Synchro handle an Occasional Pedestrian?

Trafficware

Advanced Synchro Inputs

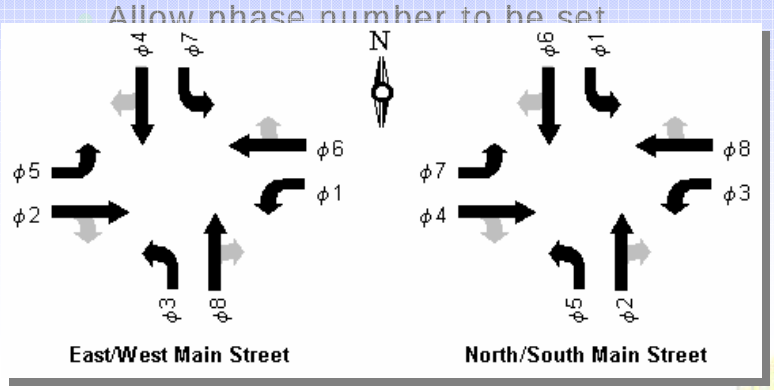
- Phase Templates
  - Allow phase number to be set automatically
  - To edit, use [Options] button

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
North South Arterial	7	4	3	8	5	2	1	6
East West Arterial	5	2	1	6	3	8	7	4

Trafficware

Advanced Synchro Inputs

- Phase Templates
  - Allow phase number to be set



Trafficware

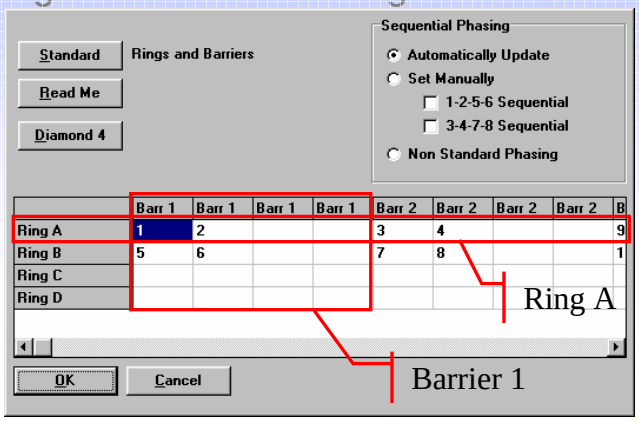
Advanced Synchro Inputs

- Ring and Barrier Designer
  - Use the [Options] button
  - Allows up to 32 Phases in 64 fields
  - Used for complex phasing schemes
  - Not needed for many common situation

Trafficware

Advanced Synchro Inputs

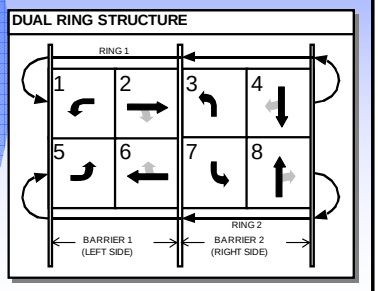
- Ring and Barrier Designer

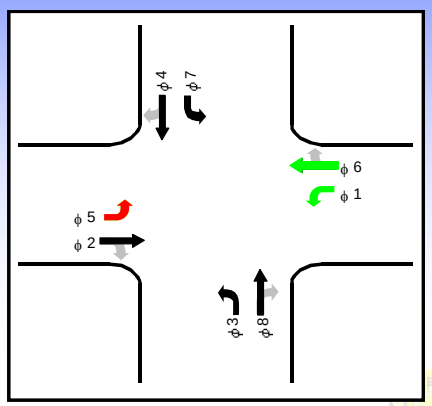


Trafficware

Advanced Synchro Inputs

- Dual-ring Operation





Trafficware

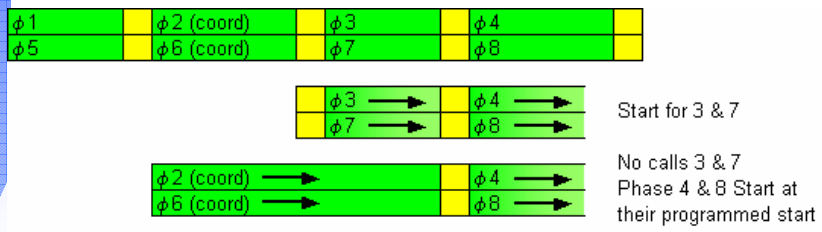
Advanced Synchro Inputs

- TPCLT Example
  - **03a Twice per cycle left turns.syn**
  - Allows a left turn to be serviced twice in the cycle

	Barr 1	Barr 1	Barr 1	Barr 1	Barr 2	Barr 2	Barr 2	Barr 2	B
Ring A	1	2			3	4			9
Ring B	5	6	15		7	8			1
Ring C									
Ring D									

Trafficware

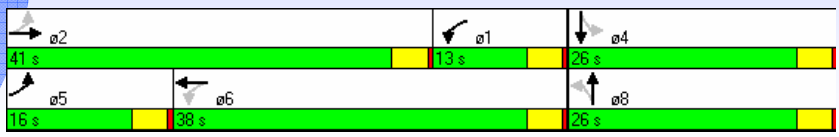
Advanced Synchro Inputs



Trafficware

Advanced Synchro Inputs

- Coordinated Recall
  - Used with Coordinated Signals
  - Used when coordinated direction has a lagging left
  - Controls when the phase can yield



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Advanced Synchro Inputs

Phases	1	2
Dual Entry	No	Yes
Recall	None	None

If there are no calls on phases 1 or 2, phase 2 will show when phase 5 or 6 is showing.

Trafficware

Advanced Synchro Inputs

Phases	1	2
Dual Entry	No	Yes
Recall	Min	None

If there are no calls on phases 1 or 2, phase 1 will show when phase 5 or 6 is showing

Trafficware

Advanced Synchro Inputs

- **Phases** 1 2

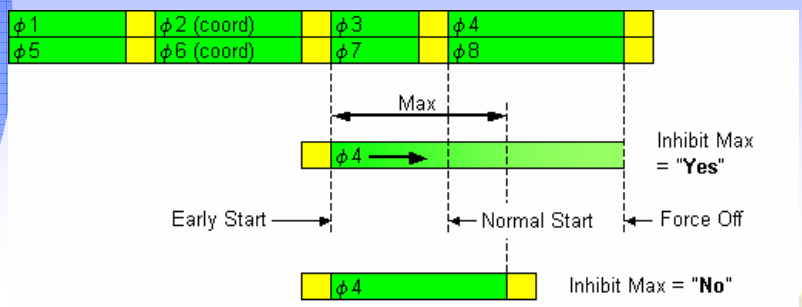
Dual Entry	No	No
Recall	None	None

If there are no calls on phases 1 or 2, no phase from this ring will show when phase 5 or 6 is showing

Trafficware

Advanced Synchro Inputs

- Inhibit Max



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Advanced Synchro Inputs

- Cluster Editor
  - Use the [Options] button to Activate
  - Connects multiple intersections to 1 controller
  - Often used with the Ring and Barrier Designer

The cluster editor is intended for use with closely spaced intersections. The advantage to operating multiple intersections with one controller is that phases at the intersections are controlled by barrier and phase positions, not by an offset. With an offset relationship, you may experience 'early release' which may be undesirable with close intersections.

Trafficware

Advanced Synchro Inputs

- Cluster Editor
  - Use the [Options] button to Activate
  - Connects multiple intersections to 1 controller
  - Used with the Ring and Barrier Designer

The cluster editor is intended for use with closely spaced intersections. The advantage to operating multiple intersections with one controller is that phases at the intersections are controlled by

Trafficware

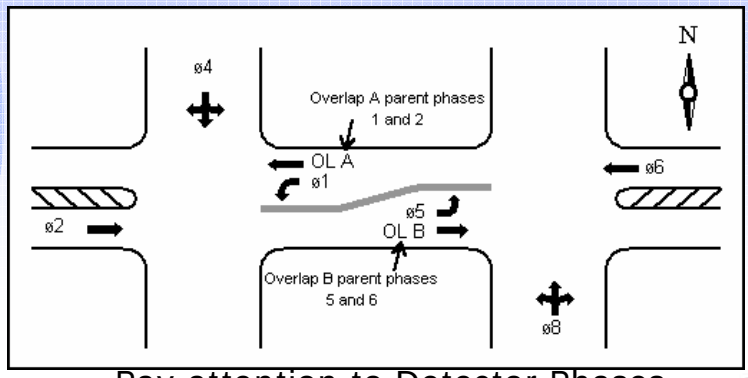
Advanced Synchro Inputs

- Coding an Overlap
  - OL allows green during different intervals
  - Common application at Diamond Interchange
  - Do not need to create 'New' phase in RB
  - Phase listed first used for Split Optimization
  - Pay attention to Detector Phases

Trafficware

Advanced Synchro Inputs

- Coding an Overlap

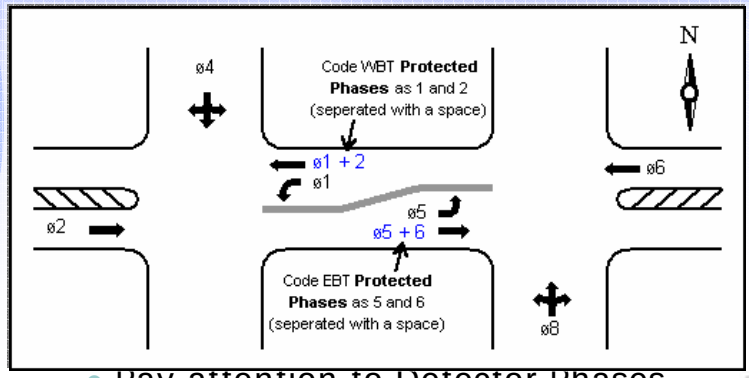


  - Pay attention to Detector Phases

Trafficware

Advanced Synchro Inputs

- Coding an Overlap



  - Pay attention to Detector Phases

Trafficware

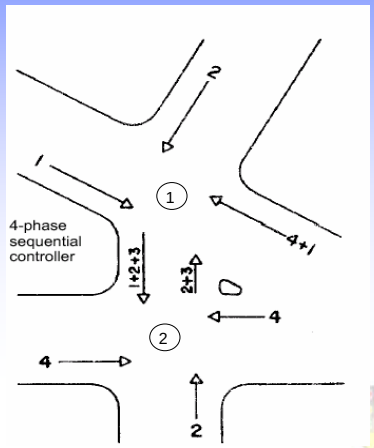
Advanced Synchro Inputs

- **IMPORTANT NOTE**
  - **IT IS VERY IMPORTANT TO SKETCH A DIAGRAM OF YOUR PHASING SCHEME FOR ADVANCED TIMING PLANS**
  - **SYNCHRO MAY ASSIST, BUT DOES NOT DETERMINE THE PHASING SCHEME**

Trafficware

Advanced Synchro Inputs

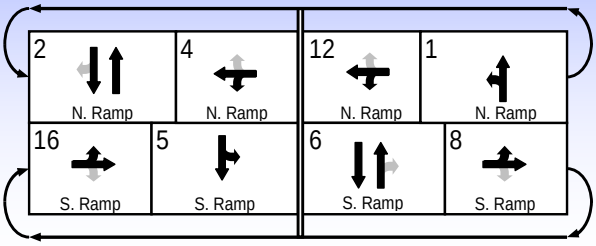
- Example
  - 4-Phase Sequential Phasing



Trafficware

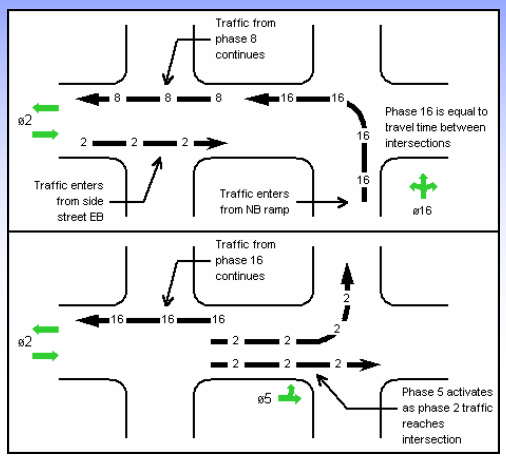
Advanced Synchro Inputs

- Example
  - Diamond with Leading Alternating



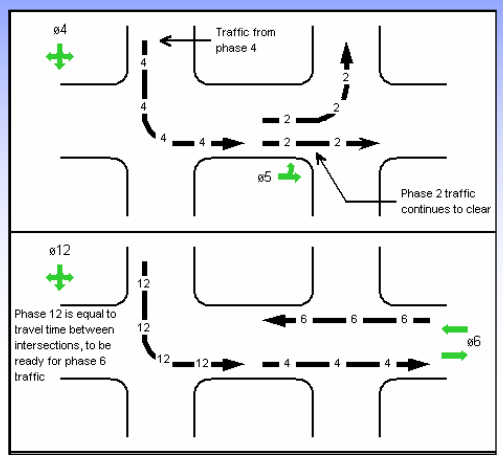
Trafficware

Diamond Leading-Alt



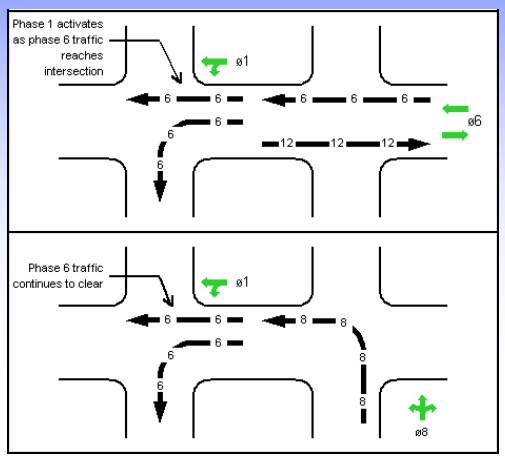
Trafficware

Diamond Leading-Alt



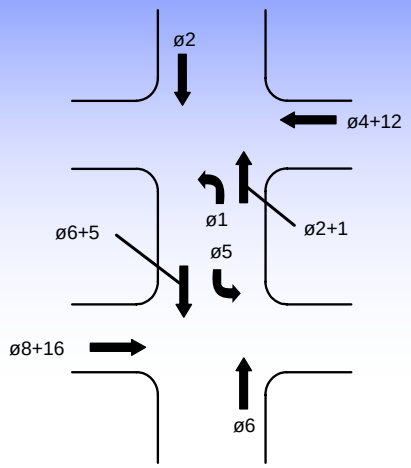
Trafficware

Diamond Leading-Alt



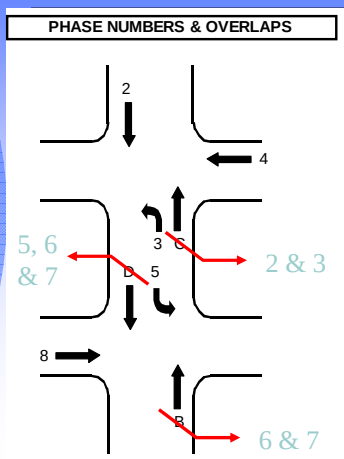
Trafficware

Diamond Leading-Alt

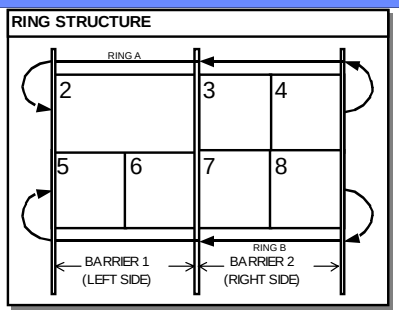


Trafficware

Advanced Synchro Inputs



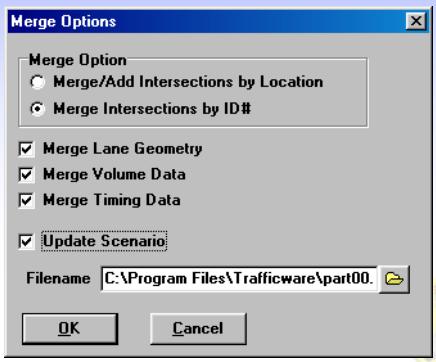
Overlap B = Phase 6 + 7
Overlap C = Phase 2 + 3
Overlap D = Phase 5 + 6 + 7



Phase	Direction	Split (sec)	Offset
2	NR NB	79.0	51
3	NR NBL/NBT	26.0	
4	NR WB	15.0	
5	SR SBL	33.0	51
6	SR NB	46.0	
7	SR NB/SB	22.0	
8	SR EB	19.0	

File and Project Management

- Merge Files
  - Use the **File→Merge-File** command to combine or merge two files



File and Project Management

- Save Part of a File
  - Select intersections to include
  - Select **File→Save-Part** command
  - Useful for Team Management
  - Allows you to simulate smaller portions of file

Trafficware

File and Project Management

- Merge Files Example
  - Merge two separate files into one larger file
- Save-Part & Merge Example

Trafficware

Optimizations

- Intersection Split Optimization
  - Attempts to provide enough green time to serve the 90th percentile
  - If not, then serve 70th percentile, the 50th
  - Extra time given to main street phases
  - Tends to give short phases a few extra seconds
  - If v/c > 1, attempt to balance v/c ratios while still respecting minimums

Trafficware

Optimizations

- Intersection Cycle Length
  - Test all cycles to determine SHORTEST cycle to clear critical percentile traffic
  - Starts with short cycle to longest cycle
  - Critical percentile traffic subject to cycle length

Cycle Length	Critical Percentile Traffic
40 - 60	90th
61 - 90	70th
91+	50th (v/c ≥ 1)

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Optimizations

- Over-Capacity Optimization
  - Cycle length with lowest Performance Index

$$PI = [D * 1 + St * 10] / 3600$$

PI = Performance Index
D = Percentile Signal Delay (s)
St = Vehicle Stops (vph)

Trafficware

Optimizations

- Network Optimization
  - The best cycle length is found by calculating a performance index
  - PI = [D * 1 + St * 10] / 3600
  - Count an un-served vehicle as 450 seconds of delay
  - In general, shorter cycle lengths have shorter uniform delay and will be favored when comparing delays of various cycle lengths.

Trafficware

Optimizations

- Network Offset Optimization
  - Passes 1,3 and 5 **individual** optimization
  - Passes 2 and 4 are **cluster** optimizations
  - Platoon dispersion not utilized
  - Checks phase order

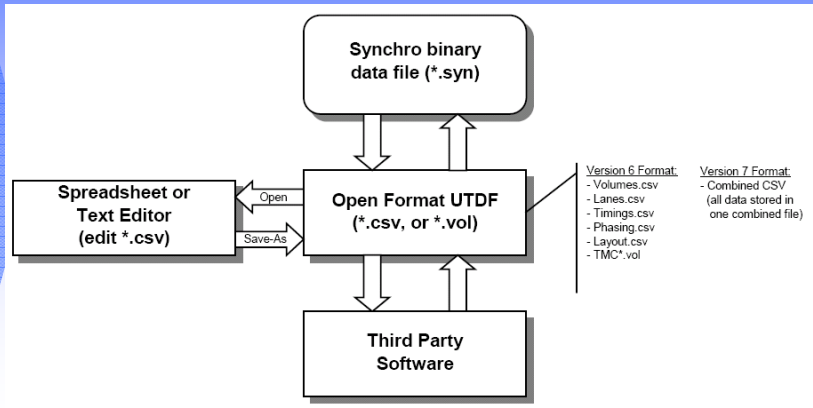
Trafficware

Universal Traffic Data Format

- Universal Traffic Data Format (UTDF)
  - Standard specification for transferring data between various software packages
  - UTDF also be used to share data between software and traffic signal controller hardware
  - UTDF useful for storing multiple volume counts and multiple timing plans for the same intersection.
  - Uses CSV and VOL formats

Trafficware

Universal Traffic Data Format



Trafficware

Universal Traffic Data Format

- Reading Volume Data (V6)
  - The Volume file(s) stores turning movement counts
  - Stores Int ID, Data, and Time of Date
  - Accepts
    - By Intersection TMC (TMC#.VOL)
    - Single file CSV (filename.csv)
    - By Date CSV (Vyymmdd.CSV)

Trafficware

Universal Traffic Data Format

- Writing Volume Data (V6)
  - Used to Store Synchro Volume Data in UTDF Format
  - Same formats as 'Read' Accepted

Trafficware

Universal Traffic Data Format

- Timing Data (V6)
  - Stores Information about the Timing Plan
  - Includes Splits, Cycle, Offset
  - Data can vary by TOD

Trafficware

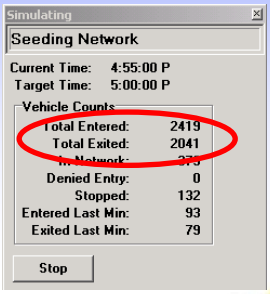
Universal Traffic Data Format

- Combined Format (V7)
  - All Data Stored in one file
  - Use File commands to Save-As CSV
  - Use File Merge to Read data into an existing network
  - Use File Open to read data into a new file
  - CSV data is easy to edit with Excel

Trafficware

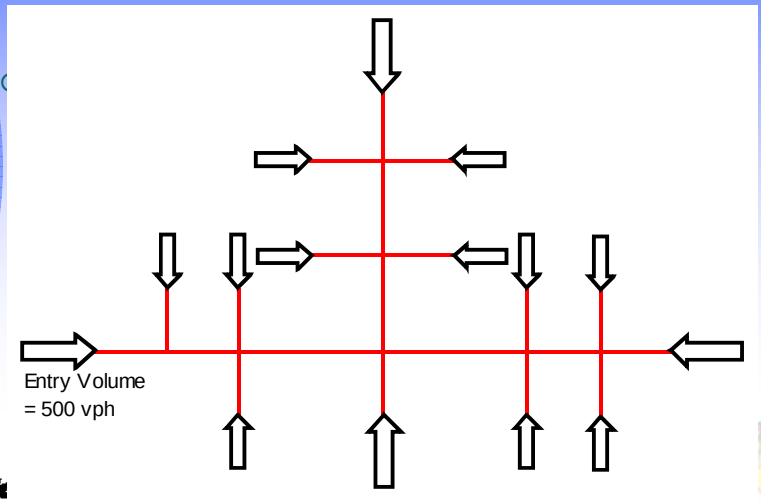
Advanced SimTraffic Features

- Intervals and Volume Adjustments
  - Interval length
  - Volume Adjustments
  - Database Parameters
  - Random Number Seed



Trafficware

Advanced SimTraffic Features



Advanced SimTraffic Features

- Multiple Simulation Runs
- Creating Multiple Simulation Report

Advanced SimTraffic Features

- Using the PHF Adjustment in SimTraffic
  - Int 1: Set **Anti PHF**, Volume simulated = (1000/4)*(1 - (1/PHF- 1)/3))=250*(1-(1/.8-1)/3)) = **229** veh
  - Int 2: Set **PHF Adjust**, Volume simulated = (1000/4)/0.8 = **313** veh
  - Int 3: Set **Anti PHF**, Volume simulated = **229**
  - Int 4: Set **Anti PHF**, Volume simulated = **229**
  - Total Volume for hour = 229*3 + 313 = **1000** vph.

Trafficware

Advanced SimTraffic Features

- Database Access
  - Volume plans read from UTDF
  - Timing plan read from UTDF
  - Model multiple intervals
    - Varying volume data
    - TOD timing plans

Trafficware

Advanced SimTraffic Features

- Vehicle Parameters
  - View and change vehicle parameters
  - Default normally acceptable
  - Synchro Heavy Vehicle entry modifies

Car1	Car2	Truck SU	SemiTrk1	SemiTrk2	Truck DB	Bus	Carpool1	Carpool2
64%	16%	60%	10%	5%	5%	20%	16%	4%

Trafficware

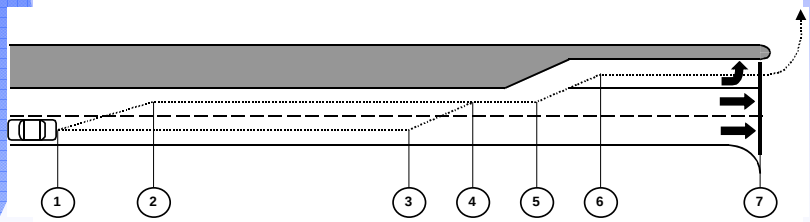
Advanced SimTraffic Features

- Driver Parameters
  - View and change driver parameters
  - Driver type 1 to 10 (conservative to aggressive)
  - Each type is 10% of total population

Mandatory Distance (ft)	—	750	—
Positioning Distance (ft)	—	1761	—
Mandatory Distance 2 (ft)	—	1174	—
Positioning Distance 2 (ft)	—	2348	—

Trafficware

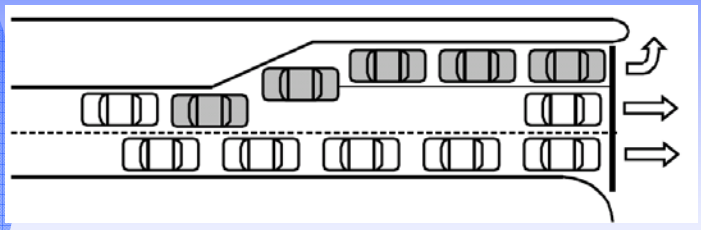
Advanced SimTraffic Features



Level II Class

- Advanced Examples

SimTraffic vs. Synchro Queues



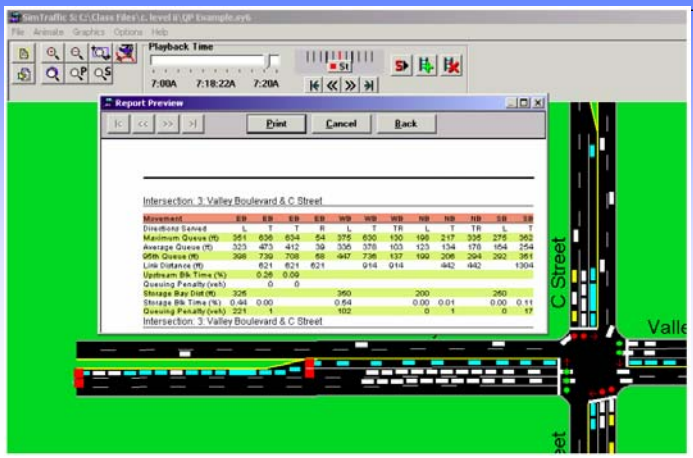
Trafficware

SimTraffic Queues

- The Maximum Queue is the maximum back of queue observed for the entire analysis interval
- The Average Queue is average of all the 2 minute maximum queues
- The 95th Queue is equal to the Average Queue plus 1.65 standard deviations
- The 95th Queue is not necessarily ever observed, it is simply based on statistical calculations

Trafficware

SimTraffic Queue Block Time



Trafficware

SimTraffic Queue Block Time

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